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Klarke et al.

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(54) **STREAMING MEDIA SYSTEM**

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(51) **Int. Cl.**

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H04N 21/426	(2011.01)
H04N 21/422	(2011.01)
H04N 21/61	(2011.01)

(52) **U.S. Cl.**

CPC ***H04N 21/426*** (2013.01); ***H04N 21/4221*** (2013.01); ***H04N 21/6125*** (2013.01); ***H04N 21/6131*** (2013.01)

(58) **Field of Classification Search**

USPC 725/110, 133, 141, 153

See application file for complete search history.

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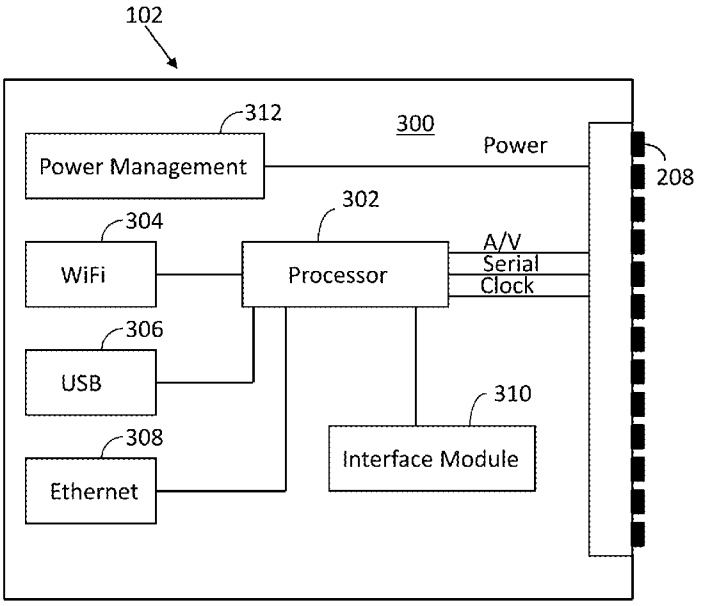
(57) **ABSTRACT**

A streaming media device includes a printed circuit board hosting components configured to access internet data. A connector is linked to the printed circuit board and adapted for connection to an audio/visual device. The connector and printed circuit board are configured to receive power from the audio/visual device. A housing encloses the printed circuit board and a portion of the connector.

10 Claims, 5 Drawing Sheets



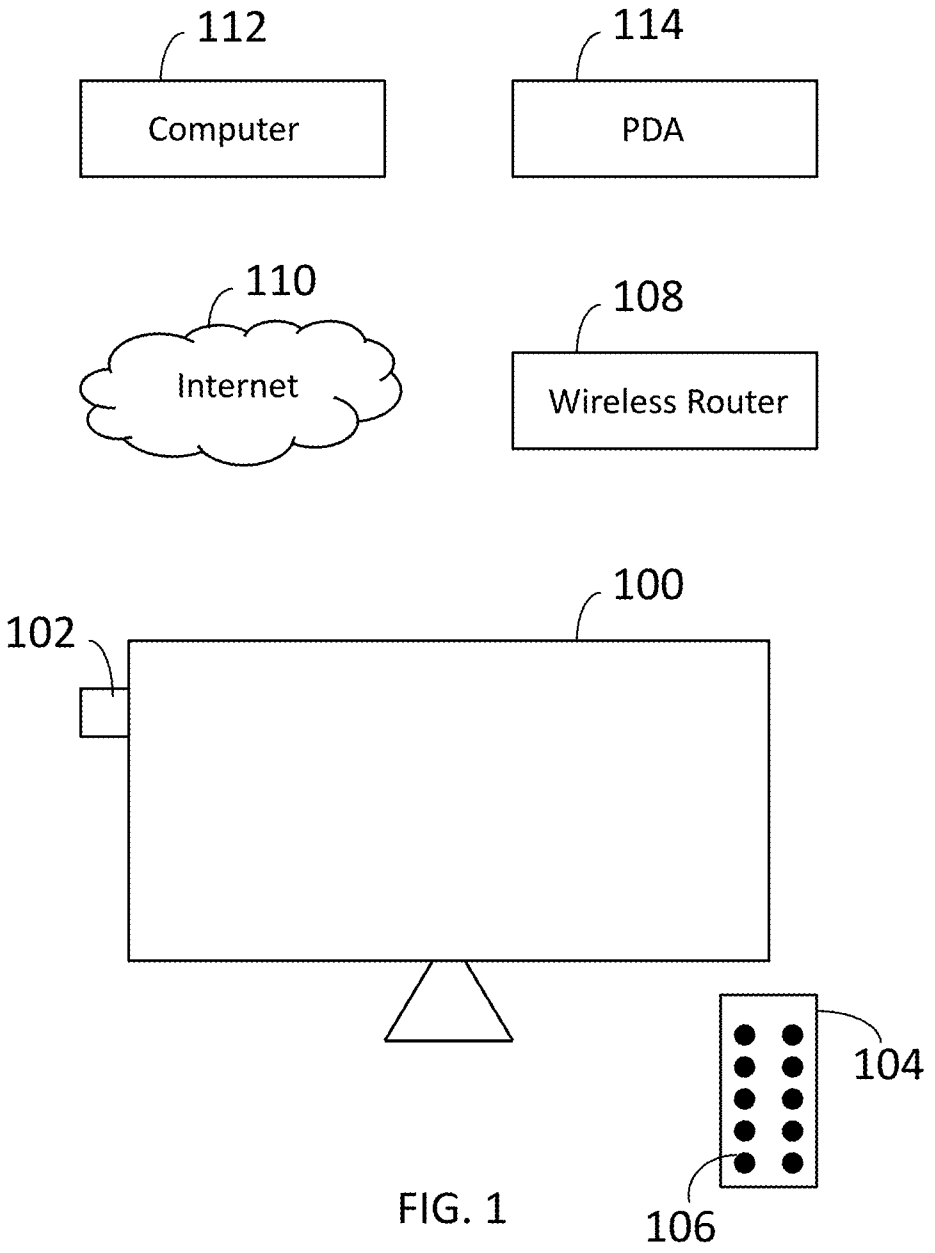

112
Computer
114
PDA
110
Internet
108
Wireless Router
100
102
104
106

FIG. 1

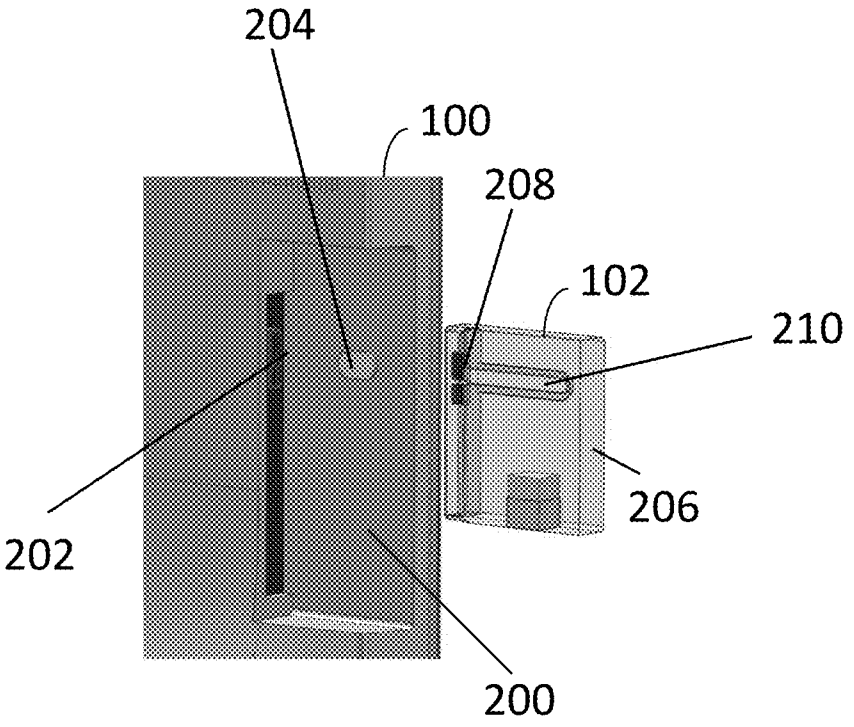


FIG. 2

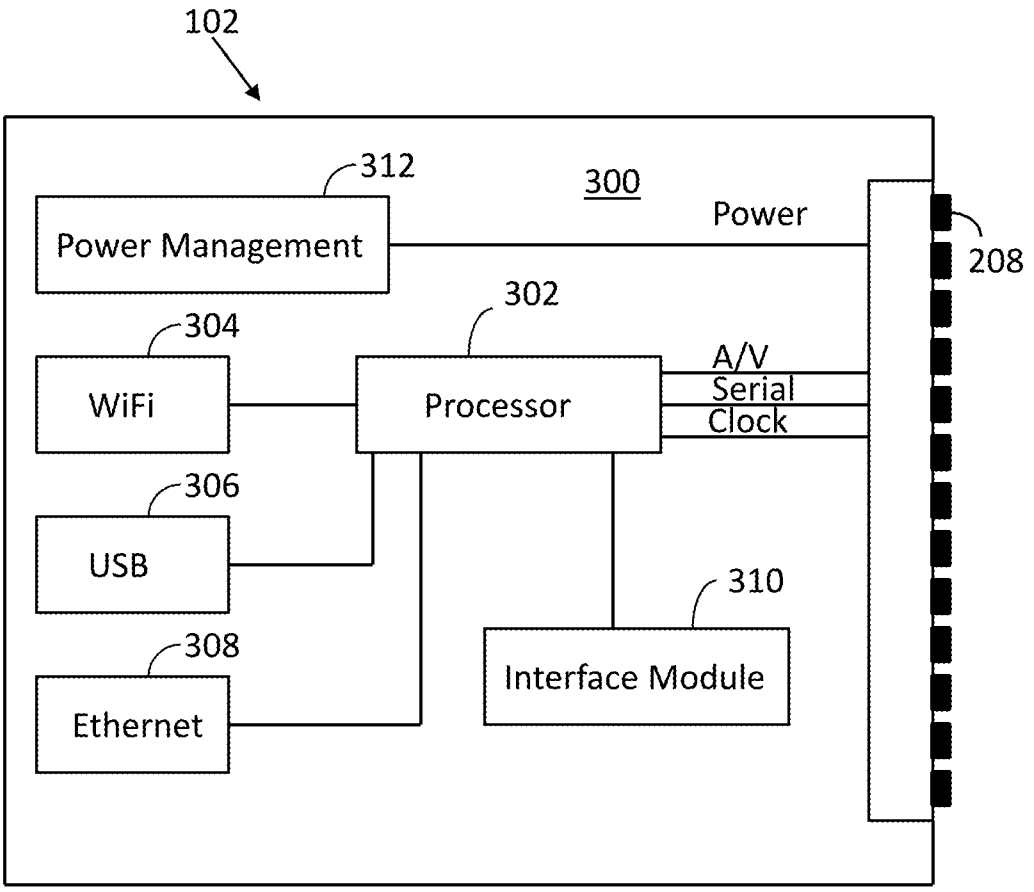

102
312
300
Power Management
Power
208
302
304
WiFi
Processor
A/V
Serial
Clock
306
USB
310
308
Interface Module
Ethernet

FIG. 3

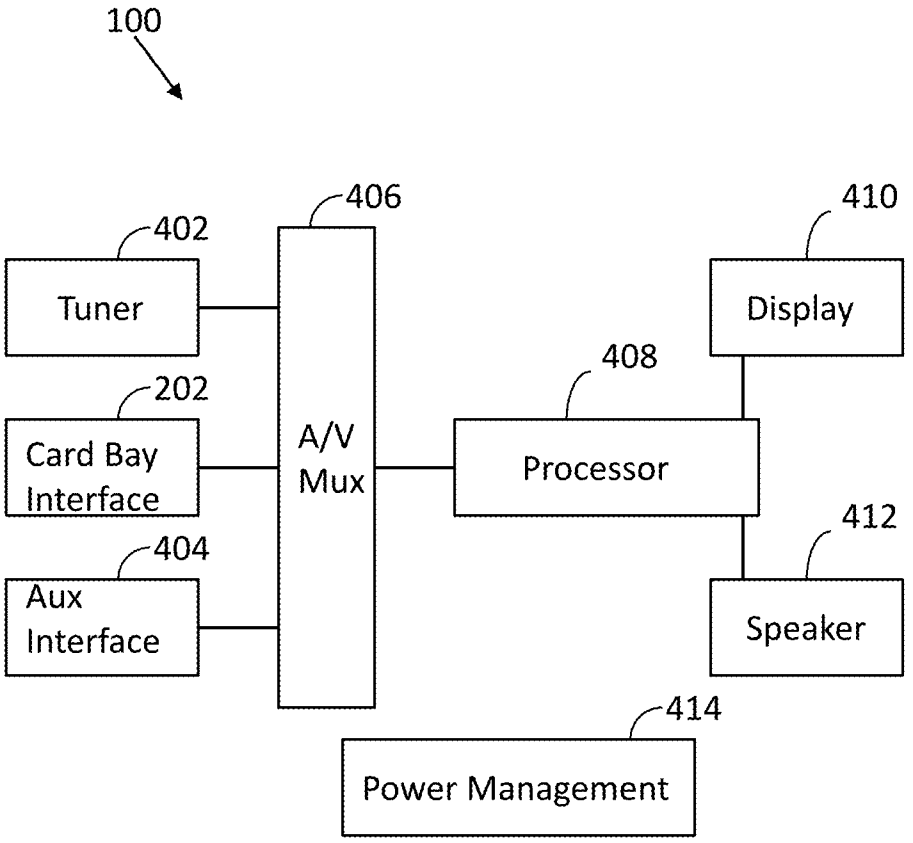

100
406
402
410
Tuner
Display
408
202
Card Bay Interface
A/V Mux
Processor
412
404
Aux Interface
Speaker
414
Power Management

FIG. 4

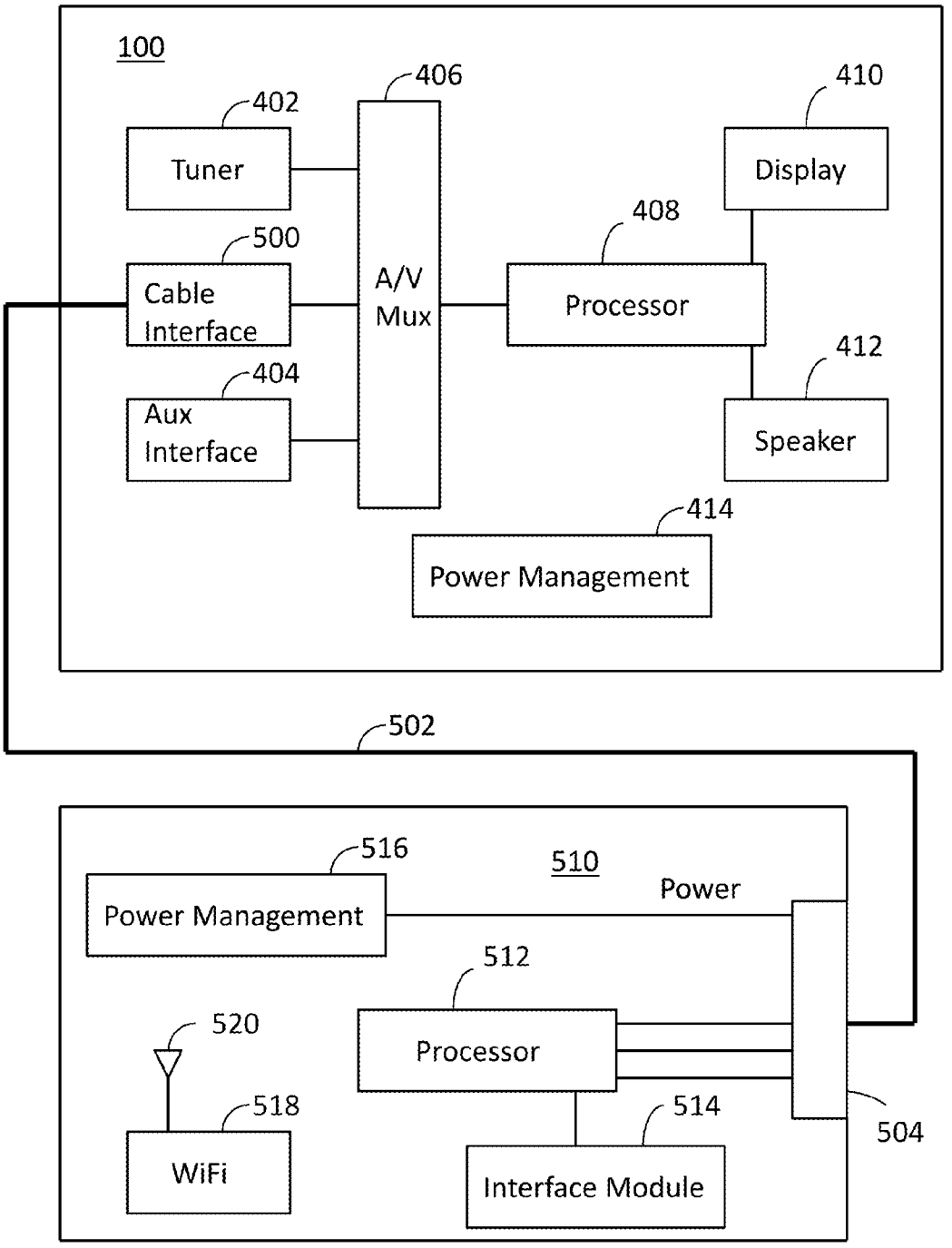

100
406
402
410
Tuner
Display
408
500
Cable Interface
A/V Mux
Processor
412
404
Aux Interface
Speaker
414
Power Management
502
516
510
Power Management
Power
512
520
Processor
518
514
504
WiFi
Interface Module

FIG. 5

STREAMING MEDIA SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of U.S. Ser. No. 13/286,122, filed Oct. 31, 2011, and entitled "Internet Access Card for Deployment within a Television."

FIELD OF THE INVENTION

This invention relates generally to television functionality. More particularly, this invention relates to a technique for augmenting television functionality through a media streaming device deployed through an audio/visual device.

BACKGROUND OF THE INVENTION

Roku, Inc., of Saratoga, Calif., the assignee of the present invention, currently offers a streaming media platform for connection to a television. In particular, the streaming media platform utilizes a cable (i.e., a High Definition Multimedia Interface or HDMI cable) to connect to external ports of a television. The streaming media platform uses a wireless connection to access the internet. Consequently, streamed media from the internet is wirelessly collected by the streaming media platform and is applied to the cable for display on a television.

There are commercially available televisions with resident internet access circuits. These internet access circuits may access the internet through a wireless connection or a wired connection, such as an Ethernet cable connection. Many purchasers are reluctant to purchase a television with a built-in internet access circuit because such purchasers do not want to be committed to a certain internet connection interface.

SUMMARY OF THE INVENTION

One aspect of the invention relates to a streaming media device. In one embodiment, the streaming media device includes a printed circuit board hosting components configured to access internet data. A connector is linked to the printed circuit board and adapted for connection to an audio/visual device. The connector and printed circuit board are configured to receive power from the audio/visual device. A housing encloses the printed circuit board and a portion of the connector.

Another aspect of the invention relates to a streaming media system. In one embodiment, the streaming media system includes a streaming media device and a remote control. The streaming media device includes a printed circuit board hosting components configured to access internet data. A connector is linked to the printed circuit board and adapted for connection to a television. The connector and printed circuit board are configured to receive power from the television. A housing encloses the printed circuit board and a portion of the connector. The remote control is capable of controlling the streaming media device and the television, and is configured to communicate directly with the streaming media device.

BRIEF DESCRIPTION OF THE FIGURES

The invention is more fully appreciated in connection with the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. **1** illustrates components associated with an embodiment of the invention.

FIG. **2** illustrates an internet access card for engagement with a television in accordance with an embodiment of the invention.

FIG. **3** illustrates components associated with an internet access card configured in accordance with an embodiment of the invention.

FIG. **4** illustrates components associated with a television configured in accordance with an embodiment of the invention.

FIG. **5** illustrates a media streaming device configured in accordance with an embodiment of the invention.

Like reference numerals refer to corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** illustrates components associated with an embodiment of the invention. In particular, the figure illustrates a television **100** with a card bay to receive an internet access card **102**, the configuration of which is discussed below. The television **100** is operative with a remote **104**, which includes buttons **106**. The television **100** as described is an example of a device that is capable of presenting audio and visual information. Such a device is commonly referred to as an audio/visual device.

FIG. **1** also illustrates the internet **110**, which is connected to a wireless router **108**. The wireless router **108** is in proximity to the television **108**, which allows the internet access card **102** to collect internet data. The wireless router **108** may also communicate with other proximate devices, such as a computer **112** and a personal digital assistant **114**.

Thus, the internet access card **102** provides an internet streaming solution as an add-on to a television. Consequently, the television manufacturer does not need to bear the cost of an internet streaming solution associated with a particular supplier. Instead, a consumer may chose from one of many internet access cards **102** and simply plugs a selected solution into the television **100**. This makes television purchasing easier since the consumer can purchase a television that is compatible with many internet streaming platforms. The consumer has the flexibility to purchase a low cost connectivity solution without being tied to a solution embedded within the television. If an internet access card **102** is not installed, then the television operates in a standard manner.

FIG. **2** is a rear view of the television **100**. The television **100** includes a card bay **200**, in this case a recessed region at the rear of the television. The card bay **200** includes a card bay electrical interface **202**, which may be in the form of a female socket.

FIG. **2** also illustrates the internet access card **102**, which includes a card housing **206**. The internet access card **102** also includes card leads **208**, which may be in the form of a male socket with double sided leads (i.e., leads on each side of a printed circuit board). The card housing **206** may include a card guide **210**. In one embodiment, the card guide **210** is a recessed region within the card housing **206**. The card guide **210** is configured to engage a protruding card bay guide **204** in card bay **200**. Preferably, this guide arrangement provides a mechanical key that allows for engagement with the card bay electrical interface **202** only when the card **102** is properly positioned. The guide arrangement also operates to support the card **102** when engaged with the card bay electrical interface **202**.

FIG. **3** illustrates electrical components associated with internet access card **102**. The card includes a set of card leads

208, which may be placed on top and bottom surfaces of a printed circuit board **300**. Exemplary pin assignments are as follows:

Pin	Side A	Side B	Comments
1	5 V	GND	Ground pins are longest
2	GND	5 V	5 V at 6 W total
3	HPD	CEC	
4	GROUND	CLK+	HDMI Out CLK + and −
5	GROUND	CLK−	
6	D0+	GROUND	HDMI Out D0 + and −
7	D0−	GROUND	
8	GROUND	D1+	HDMI Out D1 + and −
9	GROUND	D1−	
10	D2+	GROUND	HDMI Out D2 + and −
11	D2−	GROUND	
		Mechanical KEY	
12	HDMI SDA	Serial Data TX	TX from TV to Card, 119200, N, 8, 1, 3.3 V
13	HDMI SCL	Serial Data RX	RX from Card to TV, 119200, N, 8, 1, 3.3 V
14	Reset_n	FUTURE	Reset goes low to reset our card, high to run
15	TV_WakeReq_n	TV_StbyState_n	Used to wake the TV up from standby
16	Crd_StbyReq_n	Crd_StbyState_n	Standby goes low request card standby
17	FUTURE	5 V	
18	CARD_DETAn	GROUND	Ground pins are longest

The different pins may be characterized as follows.

FUTURE: This means that the line is reserved for future definition. The line is not connected in this embodiment of the card.

GND: These are the system ground pins. Preferably, they are the longest pin on the male card edge connector, such that they contact the female connector first.

5V: In one embodiment, there is 6 W of 5V power. The HDMI specification requires 4.8V to 5.3V. In one embodiment, these pins are the 2^{nd} longest pins.

HPD: This is the standard HDMI Hot Plug Detect (HPD) pin as defined in the HDMI specification for a HDMI source (TV card).

CEC: This is the standard HDMI Consumer Electronics Control (CEC) line, as defined by the HDMI specification.

CLK+, CLK−: This is the standard HDMI TMDS clock pair used to transmit data from the source (card **102**) to the sink (TV **100**).

D0+,D0−: This is the standard HDMI TMDS data pair 0 used to transmit data from the source (card **102**) to the sink (TV **100**).

D1+,D1−: This is the standard HDMI TMDS data pair 1 used to transmit data from the source (card **102**) to the sink (TV **100**).

D2+,D2−: This is the standard HDMI TMDS data pair 2 used to transmit data from the source (card **102**) to the sink (TV **100**).

Mechanical Key: This is a slot that is cut into the male connector between pins 11 and 12, and is used to make sure that the card cannot be inserted backwards.

HDMI SDA: This is the HDMI standard Display Data Channel (DDC) I2C data line used to read the EDID from the sink (TV **100**).

HDMI SCL: This is the HDMI standard Display Data Channel (DDC) I2C clock line used to read the EDID from the sink (TV **100**).

Serial Data TX: This is the Transmit serial data line with data direction from the TV **100** to the card **102**. The voltage signaling level on this card may be 3.3V. The baud rate may be 119200, and the protocol may be N,8,1. The signaling level may be specified by a Universal Asynchronous Receiver/Transmitter (UART) and may be inverted from the normal sense of 12V RS232.

Serial Data RX: This is the Receive serial data line with data direction from the card **102** to the TV **100**. The voltage signaling level on this card may be 3.3V. The baud rate may be 119200, and the protocol may be N,8,1. In one embodiment, the signaling level is from the UART and is inverted from the normal sense of 12V RS232.

Reset_n: This is the active low reset signal from the TV **100** to the card **102**. The TV **100** should hold this line low as long as there is no card inserted. When a card **102** is inserted, the TV is to keep this line low for about 200 mS, then raise this line to 3.3V. If the TV is unplugged and plugged back in, then the TV should hold the line low for 200 mS and raise the line to 3.3V. This line will not be toggled when the user turns the TV on and off

TV_WakeReq_n: The card **102** makes this signal go low to request the TV **100** to wake up. This signal is used to wake up the TV in the condition for example if the user presses a key on the RF remote **104**. Under normal conditions this signal is high.

TV_StbyState_n: This signal is low when the TV is in standby mode. It is high when the TV is in regular running mode. The TV drives this signal.

Crd_StbyReq_n: The TV **100** will bring this signal low to ask the card **102** to go into standby mode. It will bring this signal high to ask the card **102** to go back into normal power mode.

Crd_StbyState_n: The card **102** makes this signal go low when the card **102** is in standby mode; it will go high when the card **102** is in normal power mode.

CARD_DETAn: The card **102** grounds this signal when the card is inserted. It may do this by connecting this pin to a ground pin on the card **102**. The TV **100** pulls up this signal with a ~10K resistor, and then when this signal goes low it lets the TV know that a card has been inserted.

FIG. **3** illustrates the processor **302** receiving some of these signals. In particular, audio/video (A/V) corresponds to specified HDMI signals, "serial" corresponds to the UART serial signals and "clock" corresponds to the different specified clock signals. The processor **302** may be an embedded multimedia applications processor, such as the BCM 2835, sold by Broadcom, Irvine, Calif. The printed circuit board **300** also hosts a power management chip **312**, which may be the BCM959002 power management unit sold by Broadcom, Irvine, Calif. The power management chip **312** receives a power signal from leads **208**. Thus, the card **102** does not require a separate power supply. It should be appreciated that the serial link of FIG. **3** may be any communication link configured to support a specified communication protocol. The specified communication protocol may be Consumer Electronics Control (CEC), Serial Peripheral Interface Bus (SPI), Inter-Integrated Circuit (I2C) or a parallel bus.

The processor **302** is also connected to a WiFi circuit **304**, which may include one or more antennas. The WiFi circuit supports wireless communications, with for example, a wireless router. In one embodiment, there is also a Uniform Serial Bus (USB) port **306**. An Ethernet port **308** may also be provided, which allows for a hardwired connection to the internet. These ports should be exposed to the user when the card **102** is inserted in the television **100**

An interface module **310** is also connected to the processor **302**. The interface module is a set of executable instructions stored in memory, which are executed by the processor **302**. The interface module **310** provides a graphical user interface

for display on the television **100**. That is, in certain modes, the card **102** operates as a master device, while the television **100** operates as a slave device. Control signals to the television **100** may be supplied with CEC commands in the HDMI protocol. For example, an infrared receiver on the television may receive a command from a remote. The television sends the command over the internal HDMI CEC link to the card **102**. The card **102** may then provide the appropriate command back to the television **100** via an HDMI CEC link.

FIG. **4** illustrates a television **100** configured in accordance with an embodiment of the invention. The television **100** is configured to include the card bay electrical interface **202**. This interface is relatively inexpensive and therefore does not present a barrier to adoption for television manufacturers.

Other inputs may include a tuner **402** (e.g., a high definition television tuner) and an auxiliary interface **404**. An audio/visual signal source multiplexer **406** operates under the control of the processor **408** to select an audio/visual signal input. The processor **408** performs standard functions to produce a visual signal at display **410** and an audio signal at speaker **412**. The television **100** also includes a standard power management circuit **414**. Observe that the card bay electrical interface **202** provides a link to the internal electronics of the television **100**. This allows the card **102** to control the television **100**, such as to provide a graphical user interface from the interface module **310**.

In one embodiment, the card **102** is 3 inches wide, 4 inches long and 0.75 inches thick. The invention is operative with a simple remote. For example, to access streaming content, only a small set of buttons is required, which may include a home key, back key, OK key, left navigation key, right navigation key, up navigation key, down navigation key, play/pause key, double arrow left key, and a double arrow right key. Alphanumeric keys are not required. Instead, the interface module **310** provides a graphical user interface that allows a user to navigate through content using only the specified keys. The home key may be used to invoke control by the card **102**. Alternately, control by the card **102** may be invoked by using a remote to toggle through different video input selections. A separate remote may be used with the card **102**. Alternately, signals from a universal remote or dedicated remote for a television manufacturer may be mapped to operations, as specified by the interface module **310**.

FIG. **5** illustrates a media streaming device **510** configured in accordance with an embodiment of the invention. The device **510** is configured to connect with the television **100**. In one embodiment, the device **510** is configured to stream media content from a source and make the streamed media accessible to the television **100**. In addition, the device **510** can also be configured to control the functionality of the television **100**.

In one embodiment, a cable **502** operates as an interface with television **100**. Television **100** corresponds to television **100** of FIG. **4**, but instead of the card bay interface **202** of FIG. **4**, a cable interface **500** is used. In one embodiment, the cable interface **500** is a Mobile High-Definition Link (MHL) cable interface. In another embodiment, the cable interface **500** is directly connected with a connector **504** without the use of the cable **502** while still utilizing an MHL interface through a connector such as HDMI connector, universal serial bus (USB) connector, and micro USB connector. MHL is a proposed industry standard for a mobile audio/video interface for directly connecting mobile phones to high-definition televisions (HDTVs) and displays. The MHL standard features a single cable or connector with a low pin-count interface able to support up to 1080p high-definition (HD) video and digital audio while simultaneously providing power for the connected device.

In one embodiment, the cable interface **500** is configured to decode signals received from the cable **502** or through the connector **504**. In one embodiment, the connector **504** is configured to encode signals from the device **510**.

Although not a mobile phone device that is contemplated by the MHL standard, the device **510** is a dedicated device capable of streaming media to the television **100** and controlling the television **100**. The connector **504** on the device **510** may be in any number of forms because MHL is connection agnostic. Thus, the interface may be a micro Universal Serial Bus (USB) connection or an HDTV connection (e.g., HDMI).

The device **510** also includes a processor **512** and interface module **514**. The interface module **514** supports MHL standard operations along with other operations specified in connection with other embodiments of the disclosed technology. A power management circuit **516** manages the power coming into the device **510** from the television **100**. The device **510** is powered from a lead at connector **504** and via the television **100**.

A WiFi circuit **518** is also resident within the device **510**. An antenna **520** is connected to the WiFi circuit **518**. The antenna **520** may be formed on a printed circuit board (not shown) associated with the components of the device **510**. Alternately, the antenna **520** may be incorporated into cable **502** or another externally mounted device. In another embodiment, the antenna **520** is externally mounted outside the device **510** and is coupled to the device **510** via a connector. For example, an externally mounted antenna can be located away from the device **510** and near the television **100** to optimize a signal being received by the antenna **520** for use by the device **510**. In yet another embodiment, the antenna **520** is comprised of a conductive medium such as a wire and is located external of the device **510**.

In one embodiment, the remote **104** is configured to communicate with the device **510**. The interface module **514** is configured to be responsive to the remote **104**. This allows the interface module **514** to operate as a master control device, with the television **100** operating as a slave device. For example, the interface module **514** may include an infrared sensor to communicate with the remote **104**. In one embodiment, the remote **104** controls both the device **510** and the television **100**. In another embodiment, the remote **104** is configured as a simplified remote. For example, to access streaming content, only a small set of buttons is required, which may include a home key, back key, OK key, left navigation key, right navigation key, up navigation key, down navigation key, play/pause key, double arrow left key, and a double arrow right key. Alphanumeric keys are not required. Instead, the interface module **514** provides a graphical user interface that allows a user to navigate through content using only the specified keys. The home key may be used to invoke control of the television **100** by the device **510**.

In one instance, the television **100** may lack the ability to control volume selection, channel selection, and/or source selection. In another instance, the television **100** has the capability of volume control, channel selection, and source selection. In both instances, the remote **104** can serve as the primary interface and control both the device **510** and the television **100**. For example, the remote **104** is configured to control the source selection, channel selection and/or volume for the television **100** by sending the appropriate instructions through the interface module **514** of the device **510**.

In another embodiment, these instructions are further encoded by the interface module **514** from instructions from

the remote **104** into a format that can be used to control the television **100**. In one embodiment, the functionality of the interface module **514** is separated into two distinct modules; one module for interfacing with the remote **104** commands and another module for encoding instructions into another format such as the MHL interface. Further, representations of these instructions originating from the remote **104** are routed to the television **100** through the connector **504**. In one embodiment, the connector **504** utilizes the MHL interface to control the television **100**.

In use, the remote **104** is configured to control streaming media and other functionality of the device **510** in addition to controlling aspects of the television **100** such as volume, channel selection and source selection.

Alternately, control by the device **510** may be invoked by using a remote to toggle through different video input selections. A separate remote may be used with the device **510**. Alternately, signals from a universal remote or dedicated remote for a television manufacturer may be mapped to operations, as specified by the interface module **514**.

An embodiment of the present invention relates to a computer storage product with a computer readable storage medium having computer code thereon for performing various computer-implemented operations. The media and computer code may be those specially designed and constructed for the purposes of the present invention, or they may be of the kind well known and available to those having skill in the computer software arts. Examples of computer-readable media include, but are not limited to: magnetic media such as hard disks, floppy disks, and magnetic tape; optical media such as CD-ROMs, DVDs and holographic devices; magneto-optical media; and hardware devices that are specially configured to store and execute program code, such as application-specific integrated circuits ("ASICs"), programmable logic devices ("PLDs") and ROM and RAM devices. Examples of computer code include machine code, such as produced by a compiler, and files containing higher-level code that are executed by a computer using an interpreter. For example, an embodiment of the invention may be implemented using JAVA®, C++, or other object-oriented programming language and development tools. Another embodiment of the invention may be implemented in hardwired circuitry in place of, or in combination with, machine-executable software instructions.

The foregoing description, for purposes of explanation, used specific nomenclature to provide a thorough understanding of the invention. However, it will be apparent to one skilled in the art that specific details are not required in order to practice the invention. Thus, the foregoing descriptions of specific embodiments of the invention are presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed; obviously, many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, they thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the following claims and their equivalents define the scope of the invention.

What is claimed is:

1. A streaming media system, comprising:

a streaming media device configured to be directly coupled to the a television, the streaming media comprises:

a printed circuit board hosting components configured for streaming media from the internet, wherein the components include an interface module to provide a graphical user interface for display on the television to coordinate access to the streaming media from the internet,

a connector formed on the printed circuit board, wherein the connector is adapted for a direct physical engagement with externally accessible matching leads of the television such that the streaming media device is directly coupled onto the television, wherein the connector and printed circuit board are configured to receive power from the television, and

a housing enclosing the printed circuit board and a portion of the connector, wherein an entirety of the housing is configured to fit in a rear input/output bay of the television; and

a remote control capable of controlling the streaming media device and the television, wherein the remote control supplies input to the graphical user interface displayed on the television to coordinate access to the streaming media from the internet, such that the streaming media from the internet is displayed on the television.

2. The streaming media system of claim **1**, wherein the connector is a Mobile High-Definition Link connector.

3. The streaming media system of claim **1**, wherein the components include a wireless connection circuit to access internet data.

4. The streaming media system of claim **1**, wherein the components include an embedded multimedia applications processor.

5. The streaming media system of claim **1**, wherein the streaming media device is configured to control an interface of the television in response to commands received from the remote control.

6. The streaming media system of claim **5**, wherein the interface of the television includes one of: a volume parameter, a source parameter, and a channel parameter.

7. The streaming media system of claim **1**, wherein the remote control is limited to the following keys: a home key, a back key, an OK key, a left navigation key, a right navigation key, an up navigation key, a down navigation key, a play/pause key, a double arrow left key, and a double arrow right key.

8. The streaming media system of claim **1**, configured to be 3 inches wide, 4 inches long and 0.75 inches thick.

9. The streaming media system of claim **1**, wherein the connector has card leads positioned on each side of the printed circuit board.

10. The streaming media system of claim **1**, wherein the housing includes a mechanical card guide for engagement with a mechanical television guide.

* * * * *